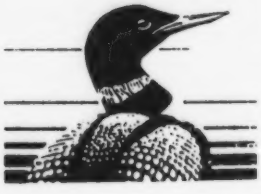
COOPERATIVE WATERFOWL MANAGEMENT PLAN

FOR

BRITISH COLUMBIA



ENVIRONMENT CANADA
CANADIAN WILDLIFE SERVICE

BRITISH COLUMBIA MINISTRY OF ENVIRONMENT
WILDLIFE BRANCH

DUCKS UNLIMITED

BRITISH COLUMBIA WATERFOWL TECHNICAL COMMITTEE

COOPERATIVE WATERFOWL MANAGEMENT PLAN

FOR BRITISH COLUMBIA

Canadian Wildlife Service
British Columbia Ministry of Environment
Ducks Unlimited Canada

January 1989

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PREFACE

In 1983 the Canadian Wildlife Service and British Columbia Ministry of Environment jointly developed a Cooperative Waterfowl Management Plan for British Columbia (McKelvey and Munro 1983). The purpose of that plan was to chart the course of waterfowl management in British Columbia for the next five years, and to form part of the Canadian input to the North American Waterfowl Management Plan, then being developed. Much of the content was derived from preliminary provincial waterfowl plans and internal Canadian Wildlife Service documents.

Since then the North American Waterfowl Management Plan has been completed and ratified by Canada and the United States (Anon. 1986). Actions have been taken to implement parts of that plan that will affect waterfowl in British Columbia. In addition the British Columbia plan has been partially implemented, and a rejuvenated Waterfowl Technical Committee has been formed. Waterfowl management in British Columbia is now coordinated by the cooperative actions of three agencies: the Canadian Wildlife Service (CWS), the Ministry of Environment (MOE), and Ducks Unlimited Canada (DU).

With the progress that has been made in the last four to five years, and the re-establishment and expansion of the Waterfowl Technical Committee, it seemed an appropriate time to modify and update this plan. The current version is the joint effort of R. McKelvey, W. Munro and E. Hennan. This plan contains some changes in the goals and objectives of the previous plan. However, the management intention is the same, and the same regular review proposed in the first plan is still an integral part of the plan.

INTRODUCTION

Waterfowl - ducks, geese and swans, are one of the more obvious and important components of British Columbia's diverse avifauna. In themselves they are important as game birds and as the subjects of such nonconsumptive uses as observation and photography. The habitats they occupy - potholes and wetlands in the interior, river valleys and estuaries, and the littoral or near-shore zone of the coast - are an integral part of the total environment, on which we all depend. Wetlands collect and store runoff and groundwater discharge, providing the ground water necessary to sustain natural vegetation and crops. They moderate the effects of drought and flooding, they prevent erosion and they play a role in water purification. The soil forming process in wetlands has resulted in the fertile deltaic soils that sustains much of our traditional agriculture while the littoral zone supports much of our aquatic food base as well as some important recreational pursuits. So by maintaining waterfowl populations and their habitats we are working towards maintainence of the environment we live in as well.

Modern wildlife management has evolved from efforts to limit harvest and apportion remaining resources, to a more holistic approach to the environment in general. That has come about from the realization that simply dividing up the wildlife resource will not ensure its continued survival, nor that of our common environment. The need for detailed information on the status of the resource has also been recognized, as has the need for well thought out and coordinated plans of action.

Migratory birds in Canada are protected by the Migratory Birds Convention Act. That act put into effect the Convention for the Protection of Migratory Birds, signed by the United States and Great Britain on behalf of Canada, in 1916. In British Columbia migratory birds are further protected under the

British Columbia Wildlife Act. Because most of the habitat on which migratory birds depend is under provincial jurisdiction, migratory bird management has become a shared federal/provincial responsibility. The Canadian Wildlife Service and the British Columbia Ministry of Environment recognize that conservation of waterfowl in British Columbia should be pursued through cooperative planning and coordinated management. Those agencies also recognize that such cooperation should extend beyond the bounds of government. To that end, this plan has been jointly developed by the two government agencies and Ducks Unlimited Canada.

This version of the British Columbia Cooperative Waterfowl Management Plan has been patterned after the North American Waterfowl Management Plan. It provides the framework for waterfowl conservation and management by describing population, habitat and use goals, by delineating objectives, and by suggesting ways to resolve problems. Regional and provincial plans developed by the British Columbia Ministry of Environment are compatible with, and have been developed to help achieve, the goals of this plan.

The planning horizon is five years, with annual reviews anticipated. As recommendations contained in it are developed and implemented further possibilities will undoubtedly become apparent. It is not intended any existing waterfowl programs should be usurped or upstaged but rather that all programs aimed at waterfowl conservation be conducted in a coordinated and efficient manner. In parallel with the North American Waterfowl Management Plan, the Waterfowl Technical Committee will develop the framework for a Pacific Joint Venture to encourage the participation of other partners and to achieve some of the objectives contained in this document.

THE STATUS OF THE WATERFOWL RESOURCE IN BRITISH COLUMBIA

Populations

Many species of waterfowl are found in British Columbia at one time or another during their life cycle. The peak breeding population is made up of approximately 1.7 million ducks representing 23 species, 30,000 Canada geese, and 100 trumpeter swans. This constitutes about 4% of the waterfowl occurring in Canada in May.

In 1983 estimates of breeding populations and production of ducks were derived from the Canada Land Inventory classification of waterfowl habitat, habitat specific studies of waterfowl, and banding and harvest data. Those estimates were based on data collected in the mid 1970's, a time when continental waterfowl populations were at peak levels. Since then the numbers of ducks have decined; the estimates calculated in 1983 therefore represent the base population level to which waterfowl managers should aspire. A population survey program was initiated in 1987 in the interior of British Columbia to improve population estimates, and to monitor population trends. To date, however, the 1983 estimates have not been altered and still represent the best available assessment of duck population size. Table 1 shows the area by capability class of the mapped part of the province and estimated areas for the unmapped regions. Table 2 shows the estimated production of ducks, about 1.2 million birds, for each capability class, and Table 3 shows the estimated breeding populations of each species.

Table 1. Estimated quantity of waterfowl breeding habitat in British Columbia, based on Canada Land Inventory capability for waterfowl production.

Capability Class	Area (km^2)		Total	
	Mapped	Unmapped	(Km^2)	(%)
1	58	119	177	0.1
2	533	190	723	0.4
3	1889	211	2100	1.2
4	6157	1327	7484	4.3
5	5228	3386	8614	5.0
6	35753	39516	75269	43.7
7	49315	28491	77806	45.2
Total	98933	73240	172173	99.9

Table 2. Estimated duck breeding densities and total production by land capability class.

Capability Class	Breeding Pairs (per km^2)	Broods (per km^2)	Young per Brood (per km^2)	Total Young (per km^2)	Total Production
1	36.3	6.6[1]	8.4	55.4	9,806[1]
2	31.5	12.4	5.3	65.7	47,501
3	30.6	10.1	7.7	77.8	163,380
4	21.7	5.2	5.3	27.5	206,558
5	23.2	4.5	6.5	29.3	252,390
6	4.0	1.1	6.5	7.2	541,937
7	1.2	-	-	-	-
Total					1,221,572

1 Class 1 habitat sample was located on high quality agricultural land, the intensive use of which has greatly reduced available habitat.

Table 3. Estimated peak number of ducks breeding in British Columbia. These numbers represent a "best estimate" of the mid 1970's abundance of ducks in British Columbia.

Species	Number (x1000)	Percent
Mallard	735.4	43.3
Pintail	51.0	3.0
American wigeon	103.5	6.1
Gadwall	12.0	0.7
Green-winged teal	19.5	1.1
Blue-winged teal	178.5	10.5
Cinnamon teal	12.0	0.7
Shoveller	8.5	0.5
Wood duck	5.0	0.3
Redhead	10.0	0.6
Canvasback	5.0	0.3
Ring-necked duck	37.5	2.2
Lesser scaup	73.0	4.3
Barrow's goldeneye	126.0	7.4
Common goldeneye	52.5	3.1
Bufflehead	126.0	7.4
Ruddy duck	25.5	1.5
Harlequin duck	8.5	0.5
Oldsquaw	.1	tr
Hooded merganser	5.0	0.3
Red-breasted merganser	15.5	0.9
Common merganser	73.0	4.3
White-winged scoter	17.0	1.0
Total ducks	1,700.0	100.0

Canada geese are the only geese that nest naturally in British Columbia and are represented by three sub-species and an introduced hybrid group that came from the stocks of several different races. Approximately 30,000 Canada geese (15,000 pairs) breed in the province and produce about 42,000 young. Information on the breeding population is summarized in Table 4. Although intensive surveys have not been undertaken, interior breeding populations are thought to be expanding, while the hybrid population, found mainly in the lower Fraser valley, is stable.

Table 4. Summary of breeding populations and production of Canada geese (*Branta canadensis*) in British Columbia.

Subspecies	Common Name	Breeding Pairs	Young Produced	Total Post-breeding Population
B. c. moffitti	western	10000	28000	48000
B. c. fulva	Vancouver	2000	5600	9600
B. c. parvipes	lesser	500	1400	2400
hybrids	-	2500	7000	12000
Non breeders (all subspecies)				15000
TOTAL		15000	42000	87000

A very small number of trumpeter swans breeds regularly in northern British Columbia, primarily in the north east. The breeding population is thought to be about 60 birds and the annual production 30 to 50 cygnets, based on surveys in 1985. There are also several local breeding populations of an exotic species, the mute swan, which was introduced from Europe within the last 100 years. It is confined to the south western coast, and is not expected to expand its range.

The patterns of waterfowl migration through the province have not been well studied but some of the more important corridors are known. Those include the Columbia valley, the Creston area, the Okanagan valley, the Fraser

River valley and plateau north of Williams Lake, the Liard River valley and the coast. Total numbers of ducks passing through British Columbia during migration may exceed 6 million birds coming from northwestern Canada (including British Columbia) and Alaska.

Northern nesting Canada geese, brant and white-fronted geese also pass through British Columbia in the fall migration, but generally only the white-fronts make any use of staging habitat. In the spring migration the same birds pass over going north but with more significant use of habitat. Small Canada geese pass through the Okanagan and Prince George areas, staging in numbers between 10,000-15,000 near Vanderhoof, while almost the entire Pacific population of brant (120,000) may stage along the east coast of Vancouver Island.

Both tundra and trumpeter swans pass through British Columbia in migration. Trumpeter swans (5,000-8,000) enroute to and from Alaska fly east of the Coast Range and move to and from coastal wintering areas through the mountains. Tundra swans (2,000-3,000) take a more easterly route over the interior plateau.

A major portion (31%) of the waterfowl wintering in Canada do so in British Columbia (Anon. 1983). At that time birds are concentrated into much smaller areas than at other times in their life cycle. Those areas are also amongst the most attractive areas to the human population and thus very apt to be rendered unsuitable for waterfowl use. Important wintering locations include the entire coast and interior areas which remain ice-free, primarily the Okanagan valley and portions of the larger interior lakes west of Prince George. Large concentrations of waterfowl, probably the largest wintering concentrations in Canada, have been well documented on the Fraser River estuary. Total wintering populations in British Columbia are estimated at

about 1 million ducks, 40,000 snow geese, 10,000 Canada geese, 500 brant and 7,500 swans.

Habitat

The distribution of waterfowl in British Columbia can be described in broad regional terms. In some respects these regions are very similar to those used by Munro and Cowan (1947) to describe the general distribution of biota in British Columbia. Similarly, they bear a resemblance to the biogeoclimatic zones of Krajina (1965). However, because waterfowl are found over such large and diverse areas, any regional habitat classification is bound to be somewhat arbitrary. The regions proposed here are a reflection of the dominant land forms, climate, vegetation, land use patterns, and our current knowledge of waterfowl habitat use. The regions are: 1) the Coast; 2) the Southern Interior; 3) the Kootenays; 4) the Central Interior; 5) the Alberta Plateau; and 6) the Northern Interior (Fig. 1). The seasonal distribution of waterfowl in each region is summarized in Table 5.

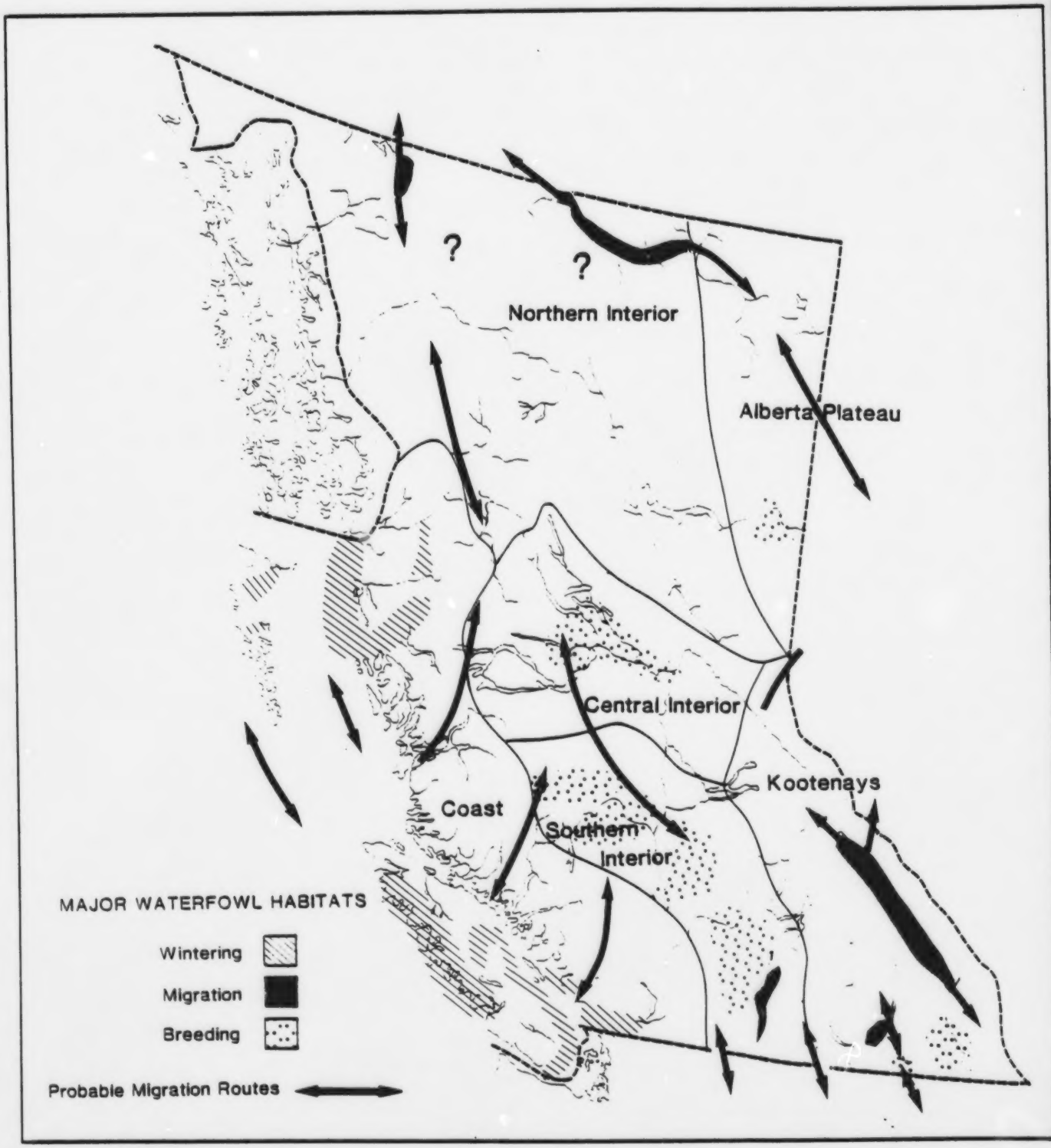

Figure 1. Waterfowl management regions of British Columbia and the approximate distribution of the major waterfowl habitats.

Table 5. Seasonal distribution of ducks, geese and swans by waterfowl regions of British Columbia.

Region	Ducks[1]		Geese		Swans	
	Breeding	Wintering	Breeding[2]	Wintering[3]	Breeding	Wintering
Coast	14%	98%[4]	37%	92%	-	80%
Southern Interior	20%	<1%	37%	8%	-	7%
Kootenays	8%	-	6%	-	-	t
Central Interior	9%	<1%	10%	-	t	13%
Alberta Plateau	28%	-	7%	-	67%	-
Northern Interior	21%	-	3%	-	33%	t
Total Birds	1.7M	1.0M	30000	60000	60	7500

1 Duck numbers found in British Columbia during the winter are not accurately known. Approximate relative distributions were calculated from available data.

2 Canada geese only.

3 Includes all geese.

4 It is estimated that 80% of the ducks wintering on the coast are diving ducks.

Coast. The coastal unit consists of the Coast Mountains and the maze of islands, tidal flats and banks, that extend almost 1,600 km from the U.S. border in the south to southeast Alaska in the north (Fig. 1). The coast mountains are deeply indented by long fiords and many creeks and rivers, including the outflows of two major rivers, the Skeena and the Fraser.

The long coastline with its many small estuaries, islands and bays contains the most important waterfowl habitat in the province. In spring and fall the coastal zone of British Columbia is a major waterfowl migration corridor. Many species move onto the coast from the north or south, and from inland breeding or wintering areas. During the winter waterfowl are found all along the coast but concentrate in the Strait of Georgia and on the Fraser River delta on the south coast, and in Hecate Strait and Dixon Entrance on the north coast. In some cases the wintering populations and migrant flocks of some species are a major portion of the world's population, e.g. trumpeter swan, Barrow's goldeneye and Pacific brant.

The major population and habitat problems identified in the coast region include the following. On the Fraser River delta urban expansion continues to directly threaten the remaining freshwater wetlands and adjacent uplands, while port and general industrial expansion continues to erode waterfront foreshore and upland habitat. Associated with both urban and industrial expansion are indirect threats from waste management and disposal, oil and toxic chemical pollution risks and a probable increase in demand for access to the waterfowl resource. Other areas of concern include crop depredation in intensively managed agricultural areas, and habitat loss to storage and sorting of logs in the Fraser River.

Major concerns in the south coast-Vancouver Island area include log storage and handling on estuaries, urbanization south of Campbell River,

increased port developments south of Nanaimo, and unmeasured sources of direct mortality such as fish net entanglement. Specific concerns on the central and northern coast include offshore oil and gas exploration, transportation and ancillary facilities associated with that exploration, port development at Kitimat and Prince Rupert/Port Simpson, possible fish net entanglement, and log handling. The unmeasured waterfowl harvest by native people also needs to be quantified.

Southern Interior. The Southern Interior region includes the Okanagan and Thompson River valleys and the Cariboo Plateau. It is an area of valleys, basins, plateaus and highlands, encircled by mountains. Agriculture in the region is primarily cattle ranching, but fruit growing and mixed farming are also important particularly in the Okanagan valley. The region is of major importance for recreation because of its scenic beauty, lakes, streams and abundant fish and wildlife populations.

The area is also important for breeding waterfowl. There is an abundance of small marshes, lakes and slow-flowing rivers which provide excellent habitat for most species. It is also a significant migration corridor for waterfowl from and to the northern and central interior areas. The region is not used extensively by wintering waterfowl, although Canada geese and tundra and trumpeter swans remain in the south Okanagan valley most years.

Major threats to waterfowl populations and habitat integrity come from ranching and logging in the Cariboo area, continued human population expansion and associated demands for land and recreation throughout the region, and site specific industrial developments such as open pit mineral extraction in the Kamloops area.

Kootenays. The Kootenay region includes the southern ranges of the Rocky Mountains, the Rocky Mountain Trench, the Columbia Mountains and the

associated valleys occupied by the Arrow Lakes, Kootenay Lake and the Kootenay River. It is an important migration corridor for waterfowl going to and from breeding grounds in Alaska, Yukon, northern British Columbia and the Northwest Territories. Of particular importance is the Columbia River from its headwaters at Columbia Lake north to Golden, a distance of approximately 120 km. The Columbia valley contains the largest single block of wetland habitat in British Columbia and is used extensively by waterfowl during migration, and to a lesser extent for breeding. Marshes, ponds and lakes on the benchlands also support a significant population of breeding ducks and geese.

Another important block of wetland habitat in the region is the delta of the Kootenay River near Creston, at the south end of Kootenay Lake. That extensive area of marsh and farmland is not only a breeding area for large numbers of waterfowl, but also a major stop-over for migrant populations both in spring and autumn. It represents one of the few remaining wetlands in the Kootenay area, where extensive hydro-electric development in recent years has eliminated much waterfowl habitat.

Potential sources of impact to waterfowl in the region include the Kootenay River diversion in the Rocky Mountain Trench, and the increased demand for recreational land throughout the area.

Central Interior. The Central Interior is that portion of central British Columbia that extends to the northern limit of effective agriculture west of the Rockies. It includes the Nechako River and the upper reaches of the Fraser and Skeena rivers. Wetlands are not extensive in any one location but are broadly distributed. Many small wetland complexes in the river valleys and rolling uplands support breeding populations of waterfowl and provide important resting and feeding areas during migration periods. The

region is not used extensively by wintering waterfowl, but is an important and apparently traditional wintering and staging area for up to 1,000 trumpeter swans.

Major threats to habitats and populations come from regional urban expansion with its attendant demands on resources, potential hydro development for use by coastal sites such as Alcan at Kitimat, and expansion of the Peace River generating capacity by diversion of the McGregor River through the Hominka marshes. Other concerns include the long term maintenance of important wintering areas for trumpeter swans, and spring staging areas for geese and swans, particularly on the Nechako River at Vanderhoof. Information that adequately delineates waterfowl habitat requirements for the latter areas is lacking. However, changes in waterfowl distributions are occurring, which may be associated with agriculture, forestry, and expanding recreational activities nearby. Waterfowl harvest by native peoples in this area also needs to be determined.

Alberta Plateau. The northeast corner of British Columbia lies east of the Rocky Mountain foothills and is part of the extensive region of central Canada known as the Interior Plains. In terms of waterfowl use and distribution it can be divided into two subzones: the grain farming area of Dawson Creek-Fort St. John (Peace River area); and the muskeg-dominated Fort Nelson lowlands.

Among the more important nesting species is the trumpeter swan, with more than half the small provincial breeding population being found there. The area also has some importance during migration but, because of the open terrain, migrations are rather broad-fronted and not particularly noticeable.

The Fort Nelson lowlands is an area of low relief and poor drainage, with many small lakes and much muskeg. Little is known of the importance of that

area to waterfowl, but productivity on a unit basis is thought to be low. However, because the area is so large and there are so many wetlands, the total waterfowl population in the area may be significant.

Specific threats to waterfowl populations and habitats include agricultural practices on existing farm lands and the expansion of agriculture into formerly forested areas. Associated with these threats are crop depredation problems on grain farms. Other threats include oil, gas and coal exploration, extraction and transport; continued hydro-electric development on the Peace River system; urban expansion and increased recreational demands.

Northern Interior. The Northern Interior is the large, mountainous portion of British Columbia north and west of Babine Lake and including the Rocky Mountains. Little is known of the waterfowl breeding in that area, but the river valleys, small lakes and muskeg are believed to provide habitat for a sparse but extensive population, which in total may be quite significant. The Liard River and associated wetlands are important waterfowl resting and feeding areas during migration, and is perhaps the major migration corridor through that part of the province. Other areas of importance include the Liard Plateau, the Liard Plain, the Dease Plain, the Nisutlin Plateau and the Teslin Plateau.

Developments of concern for the maintenance of the waterfowl population and habitat integrity in the area include hydro development of the Liard River, transmission line construction, potential large scale mineral extraction, and associated problems increased accessibility to the area would bring. The contributions of the area to the regional waterfowl population, either in terms of productivity or in the provision of staging habitat, are poorly known. Consequently the impacts of major developments cannot be readily assessed.

Uses and Mortality

There are a number of causes of waterfowl mortality including natural causes (predation, aging, disease, accident, weather), human related indirect causes (pesticides, oil spills, lead poisoning, habitat degredation), and direct human causes (legal and illegal hunting). Data from the CWS National Harvest Survey between 1967 and 1980 show that a mean of approximately 255,000 ducks and 12,000 geese were taken annually in British Columbia by about 30,000 hunters. The mean number of birds killed per hunter in that interval was 8.5 ducks and 0.4 geese. More recent estimates indicate decreases in permit sales, and birds killed per permit: in 1986 only 18,000 permits were sold in British Columbia and the estimated harvest was 124,000 ducks and 1,600 geese, or about 7 ducks and 0.9 geese per permit.

There is much current demand for appreciative use of waterfowl, and every indication that that demand will increase. The George C. Reifel Migratory Bird Sanctuary in Delta now receives 70,000-90,000 user-days per year; the Creston Valley Wildlife Management Area receives approximately 30,000 user-days per year; and many other areas attract lesser amounts of use, such as Tranquill, Columbia River marshes, Serpentine Fenn, Pitt-Addington Wildlife Management Area, Alkali Lake, Chilanko marsh, 100 Mile House marsh and Cranberry Lake. Bird watching is one of the fastest growing outoor activities in North America and waterfowl provide one of the most attractive and accessible viewing experiences.

GOALS & OBJECTIVES

Goals

There are three goals in this plan, aimed at satisfying needs in terms of populations, habitat, and use of the resource. They are:

Populations. For ducks, the following numbers will be maintained: 1.7 million birds breeding, 1.2 million produced annually, 5.5 million supported during migration, and almost 1.0 million maintained during winter. The numbers provided for will consist of viable populations of all species currently found in British Columbia.

For geese the goal is to increase the Canada goose breeding population from 30,000 to 40,000 geese in non urban areas where future management problems are unlikely; to maintain approximately 1/2 million geese of all species during migration; and to maintain a wintering population of about 60,000 geese. The wintering population will consist primarily of snow geese (up to 45,000), Canada geese (15,000) and brant (500).

The goal for swans is to maintain a minimum wintering population of 5,000 birds (95% trumpeter swans) and to maintain a minimum breeding population of trumpeter swans at no less than current levels, approximately 100 birds.

Habitat. The overall habitat goal is to maintain enough habitat so that the population goal can be attained. Approximately 50 key habitats must be secured, which in total are thought to be capable of maintaining waterfowl numbers at about 70% of the populations present in the 1970's, without enhancement.

Use. The goal for use is to provide human access to waterfowl in ways that do not threaten population or species integrity and survival.

Objectives

In order to meet the above goals, a number of objectives have been formulated and are presented below. The objectives are arranged in priority levels; each level has objectives that address some or all of the three main plan goals. The objectives within each level **should** be pursued simultaneously to manage the resource in the most efficient and effective manner.

Level One Priorities

A) Secure all the areas on the attached List of Critical Habitats (Appendix 1).

The Critical Habitats are thought to have the potential to support 70% of the waterfowl populations existing in British Columbia in the mid 1970's, during breeding, migration and wintering periods. A major effort should be directed to protecting those wetlands. The remaining 30% of the population can likely be supported on non-critical habitats which should be protected as opportunity allows.

The steps to achieving this objective are:

- determine land status;
- identify parameters and criteria necessary to describe and prioritize habitats for protection;
- collect and collate existing information;
- prioritize habitats according to bird use, threat, surrounding land use, biophysical classification;
- prepare reports that will justify protection;
- prepare proposals to secure and maintain critical habitats.

Habitat can be "secured" by a variety of means such as reservations, easements and leases. The most appropriate options should be pursued. Acquisition is an unquestionably effective, but costly last resort.

The above steps have already been taken for a number of the habitats listed in Appendix 1, and proposals for their protection have been prepared.

B) Devise, test, and initiate a sampling system to detect annual changes of ±20% in breeding population sizes, and to detect long-term changes of ±20% in wintering populations on the coast, at 90% confidence. Devise, test and initiate a sampling system to detect long-term changes of ±10% in the amount of habitat available, at 90% confidence levels.

As indicated earlier the population status of the waterfowl resource in British Columbia is only partly known. Without refinements in that data base it will be difficult to determine if population goals are being reached. Perhaps more importantly it may not be possible to detect adverse population changes in time to do anything about them.

An extensive breeding pair monitoring system was implemented in the grassland area between Merritt and Riske Creek in 1987. It was designed primarily to monitor populations of mallards and Barrow's goldeneye. The mallard was chosen because it contributes over 50% of the provincial harvest, and the Barrow's goldeneye because more than 60% of the world population breeds in British Columbia. Although designed specifically for mallard and goldeneye, information is also acquired for other waterfowl species.

It involves the resources of all three agencies, and requires 4 to 6 replicate counts on each of approximately 300 ponds. Survey design, coordination, training, collation, analysis and reporting have been the responsibility of the Canadian Wildlife Service, while all three agencies have cooperated to collect the data. This survey should be expanded to include other parts of the province, including the montane and boreal forest areas in the north.

Many factors can influence the size of wintering populations most of which will operate well away from the wintering site. Wintering surveys should initially concentrate on determining the size of the wintering population thus accurately assessing it's continental importance. Monitoring schemes will then keep track of both the numbers of birds using wintering habitats as well as assessing the status of the habitat. Changes in numbers may then be correlated

with local habitat changes or, if habitat changes are not apparent, with changes outside the region such as in the northern breeding areas.

Yet to be accomplished is a breeding habitat survey. Ultimately it should map all waterfowl habitats in British Columbia, stratifying by region, type and area; it should use remote sensing data and ground truthing; and it should monitor habitat changes over time.

By combining the results of population and habitat surveys the following should be achieved:

- an assessment of whether or not the population goal is being achieved;
- an accurate determination of how much habitat is required to meet the population goal;
- identification of potential problem areas in population and habitat management;
- a measurement of the effectiveness of management actions including such things as changes in hunting regulations, control of access, enhancement, mitigation, and passive management;
- the establishment of numerical population and habitat objectives by species or species groups.

C) Refine harvest surveys to provide estimates (±20%) of waterfowl harvest by region, and by so doing, assess the impact of harvest on specific populations.

One of the most important tools the wildlife manager has at his disposal is the regulation of the harvest. It is imperative therefore, that the size of the harvest be determined and compared with the ability of the population to support it. Waterfowl harvest is now measured through the National Harvest Survey and the Species Parts Collection. Those surveys may not be accurate enough at the local and regional level. Refirements should be made, or special surveys instituted, as necessary.

Current areas of concern are:

- impact of local harvest on breeding populations of mallard and Barrow's goldeneye in the Southern Interior and Kootenay (Creston) areas;
- the impact of harvest on snow geese wintering on the Fraser River delta;
- size and impact of harvest on brant migrating through the Strait of Georgia.

For the interior areas, efforts should entail a banding program coupled with hunter surveys. Mallards (and other dabblers) should be captured by bait-trapping between mid-June and mid-July. Barrow's goldeneye (and other divers) should be captured by drive-trapping during the month of July. Efforts should be concentrated on one region per year, with follow-up programs undertaken if, as a result of the initial findings, seasons are changed.

Harvest surveys of snow geese should be conducted annually, combined with a banding and marking program, for the next 3 to 5 years. Total Flyway harvest should not exceed the recruitment capabilities of this population; neither should the population be allowed to deplete its natural resources by becoming too large.

Pacific brant populations have shown a marked shift southward in their winter distribution over the last 15 to 30 years, perhaps in part in response to hunting pressure. The local harvest should not exacerbate this shift, nor should it unduely affect the reproductive potential of the population.

D) To aid farmers and other land owners in preventing damage to real property caused by waterfowl.

Waterfowl crop depredations are currently of a localized nature, being confined to cereal grains in the Peace River area and in the north Okanagan area, truck crops, pastures and corn fields in the Lower Mainland, and to dairy pastures in the Comox area. Nuisance problems caused by waterfowl in urban environments occur in the Okanagan, Vancouver, and Nanaimo areas.

Wildlife agencies will continue to not assume responsibility for compensation for waterfowl damage to agricultural crops or other property; efforts should center on measures to prevent such damage. Major areas of concern include: 1) crop damage in the Peace River region; 2) expanding Canada goose populations in the Okanagan and Fraser valleys.

The British Columbia Ministries of Environment and Agriculture and Fisheries are preparing a crop-damage prevention program and pamphlet for the Peace River region. Fraser Valley Canada goose problems are being addressed through a Fraser Valley Goose Management Committee. Okanagan Canada goose concerns have been addressed through a cooperative transplant program and a five year review (1982-86) of that program will assess future needs (Sterling in prep.).

E) Identify seasonal concentrations of waterfowl that are vulnerable to man-caused mortality, lessen the potential for that mortality by influencing the timing and location of proposed developments, monitor population changes that result from developments and develop emergency response capabilities.

Moulting, wintering and migrating waterfowl on the coast are particularly vulnerable to habitat loss through development and to oil and chemical spill related mortality. Contingency planning in early development stages and rapid response capability to accidental spills requires bird distributional information.

The following steps should achieve this objective:

-consolidate, map and publish existing waterfowl data, in conjunction with seabird and estuary study groups; identify information gaps;

-develop and establish response procedures.

F) Develop strategies for influencing land-use practices such that wetlands and associated upland habitats are protected and enhanced.

As outlined in the Framework for Wetland Policy in Canada (Anon. 1987) wetlands are an essential component of the environment. Without an holistic approach to resource development waterfowl habitat may inadvertently be destroyed. On a global scale resource use should be ecologically sustainable if ecological diversity and integrity are to be maintained.

The following steps should work towards meeting this objective:

- Examine land and resource use legislation, including taxation, which ultimately determines how the public and various government agencies use and manage our land. This implies an investigation, as well, of policies and practices ensuing from such legislation;
- Determine the potential for alteration of such legislation to protect or enhance waterfowl habitat;
- Encourage public education programs which improve public understanding and appreciation of wetlands and wildlife.

Level Two Priorities

A) Enhance, where feasible and desirable, critical and important habitats to provide for optimum productivity of waterfowl, and to provide for the use of the resource by humans.

Once critical habitats have been secured active management may be required to keep those areas highly attractive to waterfowl, or to improve their productivity to offset habitat losses elsewhere. The ongoing programs of Ducks Unlimited Canada, Wildlife Habitat Canada and the British Columbia Habitat Conservation Fund should work towards achieving this objective. Efforts should be made to streamline approval processes for enhancement projects, thereby allowing more resources to be directed to this objective. Special emphasis should be placed on the Water Management Branch approval process.

At least 10% of secured wetlands should have facilities developed for public use of the resource (e.g. parking facilities, trails, kiosks, toilets, towers, and pamphlets). This type of development would apply to areas such as Addington Point, Pitt Marshes, Chilanko Marsh, Bummers Flats, and Columbia Marshes. Relatively minor developments with minimal maintenance requirements would be appropriate for many sites.

B) Encourage the participation of special interest groups in planning for and managing the waterfowl resource.

The following actions should accomplish this objective:

- the Waterfowl Technical Committee should send non-government organizations copies of its annual report which should include annotated lists of committee and agency activities and publications. Agencies should also make available all appropriate technical reports to whomever

may require them;

- copies of the revised British Columbia Waterfowl Management Plan should be sent to non-government organizations in order to solicit their advice and cooperation in achieving the plan's objectives.

C) Provide guidelines for waterfowl transplants, aviculture and taxidermy.

The Ministry of Environment and the Canadian Wildlife Service should continue to review and update policies and regulations regarding the possession and handling of waterfowl for purposes of transplant, avicultural operations and taxidermy. This information should continue to be made available upon request.

D) Augment Canada goose populations by transplant of birds and by habitat improvement.

This objective should work towards the goal of increasing the Canada goose population to 40,000 in areas unlikely to cause future problems. It should involve the continuation of the annual propagation and transplant of approximately 500 young Canada geese from the Okanagan valley to the central interior area. It should also influence and be influenced by second level priority objective A. A substantial contribution in volunteer assistance in egg-collection and distribution of young birds will be required. The nature and magnitude of a continued program should be based on a review and report of the program to date.

B) Provide regulations and enforcement, coupled with education of the hunting public to a level such that 90% of persons checked in the field, in all regions of the province, are in compliance with the law.

Infractions of regulations, if they occur too frequently, will negate other waterfowl management endeavours and may jeopardize parts of the resource.

The following actions should work towards meeting this objective:

- set easily understood regulations;
- stabilize regulations to minimize annual changes;
- improve waterfowl identification skills of hunters;
- concentrate on problem areas as they become recognized;
- enhance deterrents.

LITERATURE CITED

Anonymous. 1983. Waterfowl management plan for Canada: an overview. Canadian Wildlife Service, Ottawa.

_____. 1986. North American waterfowl management plan. Canadian Wildlife Service, Ottawa, and United States Fish and Wildlife Service, Washington.

_____. 1987. Framework for wetland policy in Canada. Canada Comm. on Land Use, Ottawa.

Krajina, V.J. 1965. Biogeoclimatic zones and classification of British Columbia. Ecology of Western North America, 1: 1-17.

McKelvey, R.W. and W.T. Munro. 1983. Cooperative waterfowl management plan for British Columbia. Unpublished manuscript, Canadian Wildlife Service, Delta.

Munro, J.A. and I. McT. Cowan. 1947. A review of the bird fauna of British Columbia. British Columbia Museum Special Publication No. 2. Victoria.

APPENDIX 1

List of Critical Habitats

for

Migratory Birds

in

British Columbia

CRITICAL HABITATS FOR MIGRATORY BIRDS

Federal, provincial and private agencies concerned with the migratory bird resource in British Columbia have long recognized the need to develop a mutually agreed upon list of important habitats. Such a list would facilitate the securing of habitat, would allow for the more efficient survey, research and management work within and among the various agencies, and would help stress the significance of sites during the various environmental planning and review processes.

Such a list was developed by the Canadian Wildlife Service, British Columbia Ministry of Environment and Ducks Unlimited Canada in 1983. Since then progress has been made in both protecting and understanding the importance of those habitats. The list is currently being updated and is expected to be available in late 1989, when it will be issued as a supplement to this plan. In the mean time the interim list attached is included because the specific areas of concern have by and large not changed since 1983. The updated list will show which areas have been secured and which still require protection.

The areas described below can provide the habitat necessary to support about 70 percent of wetland-using migratory birds (largely ducks, geese and swans) which occur in British Columbia, whether breeding, wintering or migrating. The maintenance of those habitats, and in many cases their enhancement, should guarantee that viable waterbird populations will exist for the future. Loss of those habitats would have a serious impact on populations at the provincial level and, in some cases, on the national and international level.

The habitats listed are considered the most important on the basis of present knowledge. Knowledge of southern habitats is extensive but it is sparce for northern habitats. Thus, some important sites may have been

overlooked. While the habitats on this list are of provincial significance, there are many habitats in the province that are of local significance. Such areas should continue to be examined as part of ongoing programs of each agency.

Coastal habitats, for the purpose of this list, were defined as extending seaward to the 5 meter bathometric contour, a depth that includes most of the important eelgrass beds used by some species. Many migratory birds, especially seabirds, rely on ocean areas of much greater depth, and thus their requirements are not covered by this list.

The habitats are listed by geographic area within the province. They are named and briefly described, the major use by migratory birds is identified, and the approximate number of hectares involved is listed. Additional information is available from the Canadian Wildlife Service, the British Columbia Ministry of Environment, or Ducks Unlimited Canada.

CRITICAL HABITATS FOR MIGRATORY BIRDS

LOCATION	USE[1]	DESCRIPTION	AREA (ha) WETLAND	UPLAND
I COAST				
Fraser Delta				
1. Boundary Bay Complex	W & M	Includes Mud Bay. Intertidal wetland up to dyke, and adjacent uplands.	9,741	3,100
2. Roberts Bank	W & M	Intertidal wetland up to dyke and adjacent upland	11,504	*[2]
3. Sturgeon Bank	W & M	Intertidal wetland up to dyke.	7,733	*
4. South Arm Marshes and Islands	W & M	Ladner Marsh and adjacent islands in Fraser River	706	*
5. Pitt Complex	B,M & W	Pitt River to Pitt Lake, Addington Pt., Widgeon Slough, Pitt Polder and Douglas Island.	3,519	
North Coast				
6. Skeena Complex	W & M	Big Bay, Moore Cove, Porcher Island and Skeena wetlands below Ecstal.	4,125	-
Queen Charlotte Islands				
7. Naden Harbour	W & M	South of capes Naden and Edenshaw.	3,279	-
8. Delkatla/Kumdis	W & M	Masset Inlet from and including Delkatla Slough, Kumdis and Yakoun estuaries.	2,441	-
9. Skidegate Channel	W & M	Skidegate Channel through to Sandspit.	7,328	-
Vancouver Island				
10. Comox Complex	W & M	Includes Cape Lazo to Goose Spit, Courtenay Estuary and surrounding wetlands.	1,294	*
11. Baynes Sound	W & M	South tip of Denman Island to Seal Islets.	2,485	*

CRITICAL HABITATS FOR MIGRATORY BIRDS

LOCATION	USE[1]	DESCRIPTION	AREA (ha) WETLAND	UPLAND
12. Tofino Flats	W & M	Mudflats and marshes associated with Tofino Inlet.	3,067	-
13. Cowichan/Chemainus Complex	W & m	Includes Cowichan and Chemainus estuaries and surrounding freshwater wetlands.	1,930	*
II SOUTHERN INTERIOR				
Kamloops Area				
14. Thompson Rivers	B,W & M	Includes junction of north and south Thompson, S. Thompson to Campbell Creek and N. Thompson to Westside, Bachelor Hills and Knutsford area to Shumway Lake.	1,466	*
15. Douglas Plateau	B & M	Includes Nicola Lake, Stump Lake, Chaperon Lake and Minnie Lake, and the wetlands under 4000' within the polygon formed by those lakes.	4,278	*
16. Salmon Arm Foreshore	B & M	Wharf to west side of Salmon River delta.	172	-
17. 59 Mile Creek Complex	B & M	Little White Lake, Beaverdam Lake and Turans Lake.	503	*
Okanagan Valley				
18. Swan Lake and Otter Lake Complex	B & M	Lakes and upland	488	*
19. Osoyoos Wetlands	B & M	Vaseux Lake to Osoyoos Lake	821	*
Cariboo				
20. Springhouse/Alkali Lake Complex	B & M	Fraser River serves as boundary on west side.	657	*
21. 70 Mile House Complex	B & M	Green Lake, Bonaparte River, Highway 97, Hutchinson Lake and wetlands within that polygon.	875	*
22. 108 Mile House Complex	B & M	Area bounded by Mirage, Soda, Exeter and Roundup lakes.	1,068	*

CRITICAL HABITATS FOR MIGRATORY BIRDS

LOCATION	USE[1]	DESCRIPTION	AREA (ha) WETLAND	UPLAND
23. San Jose River Valley	B	Between Lac La Hache and Williams Lake.	149	*
Chilcotin				
24. Bechers Prairie Complex	B & M	Military Reserve, Bald Mtn. and strip of land between.	2,023	*
25. Chilco Ranch	B & M	Self-explanatory	101	*
26. Chilanko Forks	B & M	Self-explanatory	345	*
27. Chilcotin Lake	B & M	Self-explanatory	536	-
28. Stum Lake	B	Self-explanatory	810	-
29. Towdystan/Abuntlet Lakes	B & M	Includes those lakes and wetlands between	686	*
30. Lonesome Lake	W	Lake only.	405	-
III KOOTENAYS				
31. Upper Columbia River Valley	B & M	Canal Flats to Blueberry River	17,873	*
32. Creston Valley	B & M	Area from U.S. border to Kootenay Lake.	6,873	*
IV CENTRAL INTERIOR				
33. Vanderhoof	M	Nechako River within the Migratory Bird Sanctuary	171	-
34. Fraser Lake Complex	W & M	Includes east and west ends of Fraser Lake, Nautley River and Stellako River.	406	*
35. Stuart River	W	Lake outlet to 10 miles downstream of Fort St. James.	448	-
36. Crooked River	W	Between Kerry Lake and Davie Lake.	329	-

CRITICAL HABITATS FOR MIGRATORY BIRDS

LOCATION	USE[1]	DESCRIPTION	AREA (ha) WETLAND	UPLAND
V NORTHERN INTERIOR				
37. Liard River	M	From Lower Post to Toad River	12,389	-
38. Irene Lake and Torpid Creek area	M	The lake, creek and associated wetlands	3,271	*
39. Triangle Lake area	B & M	Triangle Lake and wetlands between it and the Yukon border.	694	-
40. Upper Teslin River	M	Jennings River delta, Teslin River (Lake Arm), Hutsigola Lake to Hyland Lake.	3,270	-
VI ALBERTA PLATEAU				
41. Cecil Lake	B & M	Lake and uplands	671	*
42. Boudreau Lake Complex	B & M	Bounded by the Moberly, Pine and Peace rivers and Moberly Lake.	1,144	*
		TOTAL	122,074	

1 - B = Breeding; M = Migration; W = Wintering.

2 * areas to be calculated for revised list, in preparation.